AMENDMENTS TO THE CLAIMS

1. (Currently amended) A method for bonding materials using localized microwave energy comprising:

applying a thin coating of a joining material to each surface of the base materials being joined;

disposing each said base material such that the surface of the base materials being joined form a joint area and are in contact with the desired alignment and pressure necessary for maintaining the contact between the materials and creating the desired component assembly;

heating said joint area with a microwave beam applied to the surfaces of the base material being joined to achieve localized heating of the joint area, said heating including:

heating said joint area to an initial joining temperature, wherein said joining material softens and fills physical discontinuities between the surfaces of the base materials being joined, and

rapidly heating said joint area to the reactive temperature of the joining material and the base materials;

maintaining said joint area at said reactive temperature to allow for the interdiffusion of the base and joining materials and formation of a homogenous joint region;

rapidly cooling said joint area to a recrystalization temperature and maintaining said joint area at the recystalization temperature for a predetermined period; and

slowly cooling said joint area to room temperature.

2. (Original) The method of claim 1 wherein said joining material is a frit selected such that at a predetermined temperature the constituents of the frit material will chemically react and diffuse into the base material to form stable refractory compounds.

3. (Original) The method of claim 2 wherein said joining material is chemically reactive with the base material at a temperature below that of the thermal degradation threshold of the base material.

4. (Original) The method of claim 1 wherein said base materials are disposed and joined to create the desired assembly by employing low temperature fixtures to align said base materials and provide pressure to said joint area in the desired manner to produce the completed structure.

5. (Original) The method of claim 4 wherein said fixtures do not reach a temperature above 100 degrees Centigrade during the heating phases of the joining process.

6. (Original) The method of claim 1 wherein said initial joining temperature is approximately 800 to 1200 degrees Centigrade.

7. (Original) The method of claim 1 wherein said joint area is heated from the initial joining temperature to said reactive temperature at a rate of approximately 100 degrees Centigrade a minute.

8. (Original) The method of claim 1 wherein said reactive temperature is approximately 1500 to 1700 degrees Centigrade.

9. (Original) The method of claim 1 wherein said joint area is maintained at the reactive temperature for an interval of approximately 10 minutes.

10. (Original) The method of claim 1 wherein said recrystallization temperature is approximately 800 to 900 degrees Centigrade.

11. (Original) The method of claim 1 wherein said joint area is maintained at the recrystallization temperature for approximately 30 minutes, or until the joint area forms a stable physical and thermal structure.

12. (Original) The method of claim 1 wherein said base materials are high purity oxide materials.

13. (Previously Presented) The method of claim 4 wherein said low temperature fixtures do not reach temperatures above 100 degree Centigrade.

14. (Withdrawn) A multi component assembly formed by joining various base materials together having homogenous joints between said base materials formed by:

applying a thin coating of a joining material to each surface of the base materials being joined,

disposing each said base material such that the surface of the base materials being joined form a joint area and are in contact with the desired alignment, and pressure necessary for maintaining the contact and creating the desired component assembly,

heating said joint area with a microwave beam applied to the surfaces of the base material being joined to achieve localized heating of the joint area,

heating said joint area to an initial joining temperature, wherein said joining material softens and fills physical discontinuities between the surfaces of the base materials being joined,

rapidly heating said joint area to the reactive temperature of the joining material and the base materials,

maintaining said joint area at said reactive temperature for a short interval to allow for the interdiffusion of the base and joining materials and formation of a homogenous joint region,

rapidly cooling said joint area to a recrystalization temperature and maintaining said joint area at the recystalization temperature for a predetermined period,

slowly cooling said joint area to room temperature,

wherein said joint region features similar physical, thermal and electrically characteristics as the base materials.

15. (Withdrawn) The device of claim 14 wherein said base materials are comprised of high temperature ceramics.

16. (Withdrawn) The device of claim 14 wherein the joining material used to coat the surfaces of the base materials being joined is largely eliminated from the joint regions by joint area heating.

17. (Withdrawn) The device of claim 15 wherein said base materials are comprised of high temperature ceramics having a purity of greater than 99%.

18. (Currently Amended) A method for bonding materials using localized millimeter wave energy comprising:

applying a thin coating of a joining material, which is chemically reactive with the base material at a predetermined temperature, to each surface of the base materials being joined,

disposing each said base material such that the surface of the base materials being joined form a joint area and are in contact with the desired alignment and pressure necessary for maintaining contact between the base materials and creating the desired component assembly,

heating said joint area with a beam of millimeter wave energy applied to the surfaces of the base material being joined to achieve localized heating of the joint area, said heating including:

heating said joint area to an initial joining temperature, wherein said joining material softens and fills physical discontinuities between the surfaces of the base materials being joined, and

rapidly heating said joint area to the reactive temperature of the joining material and the base materials,

maintaining said joint area at said reactive temperature to allow for the interdiffusion of the base and joining materials such that the reactive material diffuses away into the bonded base material forming of a homogenous joint region,

rapidly cooling said joint area to a recrystalization temperature;

maintaining said joint area at the recystalization temperature for a predetermined period, and cooling said joint area to room temperature.

19. (Currently Amended) The method of claim 18, wherein said rapidly heating said joint area to the reactive temperature of the joining material and the base materials comprises heating at a rate of ~~at least~~ 50 degrees C per minute to 100 degrees C per minute.

20. (Currently Amended) The method of claim 18, wherein the millimeter wave energy has a frequency of ~~84.5~~ 83 GHz.

21. (Previously Presented) The method of claim 1, further comprising:
transmitting the beam through optics toward the joint area.

22. (Previously Presented) The method of claim 1, wherein the beam has a diameter of at most five centimeters.

23. (Previously Presented) The method of claim 1, wherein the beam has a diameter of between four and five centimeters.

24. (Previously Presented) The method of claim 1, wherein the beam has a spot size of one centimeter.

25. (Previously Presented) The method of claim 1, wherein said localized heating is limited to an area with a diameter of two to five centimeters.

26. (Previously Presented) The method of claim 1, further comprising:
maintaining said joint area at the initial joining temperature for a predetermined period.

27. (Previously Presented) The method of claim 1, wherein the initial joining temperature is about 1200 degrees C.

28. (Currently Amended) The method of claim 1, wherein said rapidly heating said joint area to the reactive temperature of the joining material and the base materials comprises heating at a rate of ~~at least~~ 50 degrees C per minute to 100 degrees C per minute.

29. (Currently Amended) The method of claim 1, wherein the joint area is maintained at the reactive temperature for ~~short interval is~~ about five minutes.

30. (Previously Presented) The method of claim 1, wherein the joining material is chemically reactive with alumina at 900 degrees C.

31. (Previously Presented) The method of claim 1, wherein the base material is alumina.

32. (Previously Presented) The method of claim 1, wherein the joining material is a glass frit comprising calcium oxide.

33. (Cancelled)

34. (Currently Amended) ~~The method of Claim 33, further comprising:~~ A method for bonding base materials using localized millimeter wave energy comprising:

applying a joining material to coat each surface of the base materials being joined,

disposing each said base material such that the coated surfaces of the base materials being joined are in contact and form a joint area,

heating said joint area with a millimeter wave beam to an initial joining temperature,

heating said joint area with a millimeter wave beam from the initial joining temperature to a reactive temperature of the joining material and the base materials,

maintaining said joint area at said reactive temperature for a predetermined period,

cooling said joint area to a recrystalization temperature,

maintaining said joint area at the recrystalization temperature for a predetermined period, and

cooling said joint area to a temperature below the recrystalization temperature.

35. (Currently Amended) A method according to claim 34 ~~33~~, wherein the millimeter wave beam is generated by a gyrotron.

36. (Currently Amended) A method according to claim 34 ~~33~~, wherein said heating said joint area to the reactive temperature of the joining material and the base materials comprises heating at a rate of ~~at least~~ 50 degrees C per minute to 100 degrees C per minute.

37. (Previously Presented) A method according to claim 4, wherein the low temperature fixtures comprise at least one of a steel and a boron nitride ceramic.